STERIS®

MAINTENANCE MANUAL

Carbon Steel Electric Steam Generator
Amsco® Power Pack (Type CH02 through CH14)

(02/01/00)
Rev. 1

P-764327-966

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STERIS

INSTALLATION, OPERATION
And RENEWAL PARTS IDENTIFICATION

CARBON STEEL
Electric Steam Boiler
Type CH02 – CH14

Standard Trim – 100 PSI
0-90 PSI Operation Pressure

Model Number _____	Power Circuit Voltage _____
Boiler Serial Number _____	Control Circuit Voltage _____
National Board Number _____	Amp _____ Ph _____ Cy _____
Customer to complete for future reference	

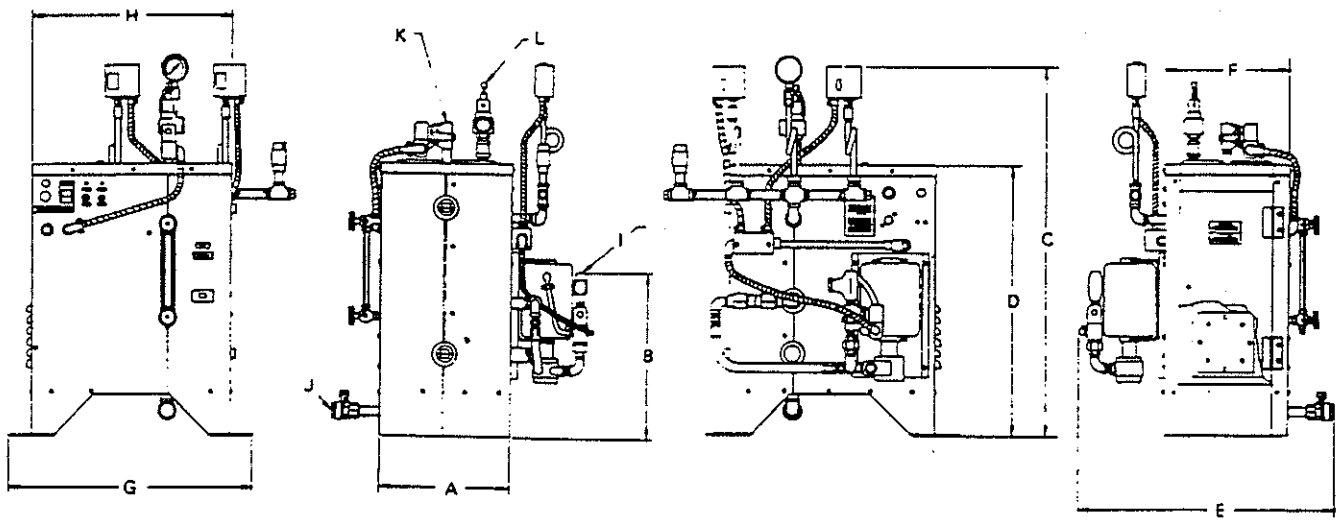
SPECIFICATIONS

Three Phase Voltage											
				Quantity and rating of contactors			Quantity and rating of heater fuses				
Catalog Number	kW	B.H.P. Rating	Output in lbs./hr at 80 psi with 140° F feedwater	208	240	480	208	240	480	No. and kW of heating elements	
CH02	10	1	31.6	1-40	1-40	1-40	--	--	--	1-10 kW	
CH03	15	1.5	47.4	1-50	1-40	1-40	3-60	--	--	1-15 kW	
CH04	20	2	63.2	1-65	1-50	1-40	3-70	3-60	--	1-20 kW	
CH05	30	3	94.9	2-50	2-50	1-40	6-60	4-45	--	1-30 kW	
CH06	40	4.1	126.5	2-65	2-50	1-50	6-70	6-60	3-60	2-20 kW	
CH07	60	6.1	189.7	4-50	4-50	2-50	12-60	12-50	6-50	2-30 kW	
CH08	75	7.7	237.2	4-65	4-50	2-50	12-70	12-60	6-60	2-37.5 kW	
CH10	102	10.4	322.5	6-50	6-50	3-50	18-60	18-60	9-60	3-34 kW	
CH12	120	12.2	379.5	6-65	6-50	3-50	18-70	18-60	9-60	3-40 kW	
CH13	150	15.3	474.3	8-65	8-50	4-50	24-70	24-60	12-60	4-37.5 kW	
CH14	180	18.4	569.2	8-65	8-65	4-65	24-80	24-70	12-70	4-45 kW	

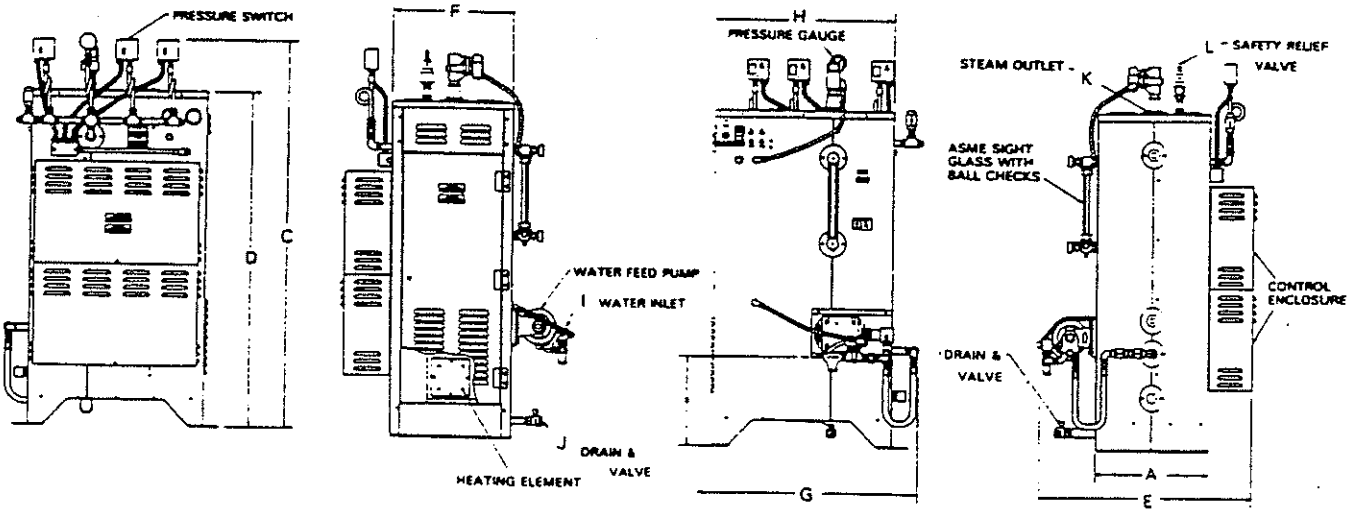
P-764327-966, Rev. 1

DIMENSIONS

MODELS CH02 THROUGH CH04



MODELS CH05 THROUGH CH14



DIMENSIONS (IN INCHES)

Catalog Number	A	B	C	D	E	F	G	H	I	J	K	L
CH02	12 -3/4	19 -1/2	35	27 -1/4	29 -11/16	12 -3/4	24 -3/8	20	1/ 2	1/ 2	1/ 2	1/ 2
CH03	12 -3/4	19 -1/2	35	27 -1/4	29 -11/16	12 -3/4	24 -3/8	20	1/ 2	1/ 2	1 /2	1/ 2
CH04	12 -3/4	19 -1/2	35	27 -1/4	29 -11/16	12 -3/4	24 -3/8	20	1/ 2	1/ 2	1 /2	1/ 2
CH05	15	4	43 -7/8	35 -7/8	30 -3/8	15	28 -5/8	24-3/16	1/ 2	1	3 /4	1/ 2
CH06	15	4	43 -7/8	35 -7/8	30 -3/8	15	28 -5/8	24-3/16	1/ 2	1	3 /4	1/ 2
CH07	15	4	43 -7/8	35 -7/8	30 -3/8	15	28 -5/8	24-3/16	1/ 2	1	3 /4	1/ 2
CH08	15	4	43 -7/8	35 -7/8	30 -3/8	15	28 -5/8	24-3/16	1/ 2	1	3 /4	1/ 2
CH10	18	17 -5/8	60	50 -7/8	34 -1/4	18	33 -1/8	27 -3/16	1/ 2	1	1	3/ 4
CH12	18	17 -5/8	60	50 -7/8	34 -1/4	18	33 -1/8	27 -3/16	1/ 2	1	1	3/ 4
CH13	18	17 -5/8	60	50 -7/8	34 -1/4	18	33 -1/8	27 -3/16	1/ 2	1	1	3/ 4
CH14	18	17 -5/8	60	50 -7/8	34 -1/4	18	33 -1/8	27 -3/16	1/ 2	1	1	3/ 4

INSTALLATION

WARNING - Hazard of electrical shock and severe burn: Injury or death may occur if this equipment is not properly installed and operated. The boiler must be grounded using the grounding means provided and be wired in accordance with the National Electrical Code by a qualified person after reviewing the installation and operating instructions for your electric steam boiler.

NOTE: When installing the boiler, allow sufficient room (18 inches minimum) to allow removal of the heating element if and when necessary.

1. The boiler should be mounted on a solid, level foundation, near floor drain. Provisions should be made to prevent damage in the event the boiler leaks water or discharges steam.
2. A minimum distance of 18 inches between the boiler and any combustible material must be maintained.
3. Complete all piping to the boiler. Connect the water line to the fitting on the pump and the motor assembly.
4. When using any type of water feed other then the pump feed provided with the boiler, the incoming water supply must be 10 psig greater then the operating pressure of the boiler. This is required to maintain a proper water level in the boiler. Failure to maintain the proper water level may cause heater failure. Keep the feed water line valve open at all times except during blowdown.
5. Connect the steam line, using a globe valve, to the boiler steam outlet. The valve should be placed as close as possible to the boiler outlet and sized per the label on the boiler.
6. To maximize the efficiency, all steam piping from the outlet should be insulated.
7. Drain and relief valve piping should be installed in accordance with state and local codes.
8. Only a qualified person, aware of local and national electrical and plumbing codes, should install this equipment.

WATER SPECIFICATION

STERIS recommends supplying the boiler with hot water at 140° F or 60°C, (Maximum 150°F or 65°C) to minimize the heat-up time and conserve electricity. Colder water can be used but will result in a longer heat-up time and reduced steam output.

Feed water varies considerably with site location. For proper boiler operation and reasonable element life, STERIS recommends the feed water quality be controlled within the following parameters.
The recommended total hardness should be 0-17 mg/l, specific resistance not to exceed 26,000 Ω/cm with pH maintained between 6.8 and 7.5. Total dissolved solids should not exceed 250 PPM and alkalinity (bicarbonate only) should not exceed 180 PPM as calcium carbonate.

If the available feed water source does not meet the above requirements, contact a water treatment company for recommendations for water supply modifications. Failure to supply water within the above specifications may decrease the boiler life and may cause failures not covered by equipment warranty.

ENGINEERING DATA

Rating (kW)	10	15	20	30	40	60	75	102	120	150	180
Boiler Horsepower	1	1.5	2	3	4.1	6.1	7.7	10.4	12	15.3	18.4
Steam output in lbs./hr at 80 psig with 140° F feedwater	31.6	47.4	63.2	94.9	126.5	189.7	237.2	322.5	379.5	474.3	569.2
Gross output in BTU/hr	34,120	51,180	68,240	102,360	136,480	204,720	255,900	348,024	409,440	511,800	614
Approx. operating weight in lbs. (kg)	230 (104)	230 (104)	230 (104)	400 (181)	410 (186)	420 (190)	430 (195)	940 (425)	945 (428)	950 (430)	960 (435)
Electrical consumption in Amps											
208 Volt, 3 Phase	28	42	56	83	111	167	210	283	333	416	500
240 Volt, 3 Phase	24	36	48	72	96	144	180	245	289	361	433
480 Volt, 3 Phase	12	18	24	36	48	72	90	123	144	180	217
Water consumption in gph (lph) at Steam output of 80 psi with 140 F feedwater	3.8 (14.4)	5.7 (21.6)	7.6 (28.8)	11.5 (43.5)	15.2 (57.5)	22.7 (85.9)	28.4 (107.5)	38.7 146.5	45.5 (172.2)	56.9 215.4	68.2 (258.1)
Approx. heat loss in BTU/hr at 70°F ambient continuous operation	850	850	850	1750	1750	2600	3500	4400	4800	4800	4800

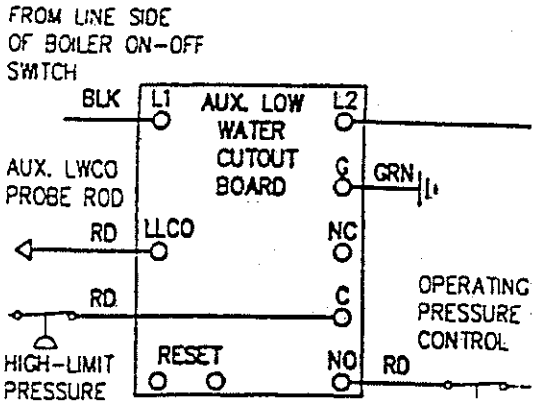
WIRING

WARNING - Hazard of electric shock: A qualified individual must effectively ground any installation involving electric heaters in accordance with the National Electrical Code.

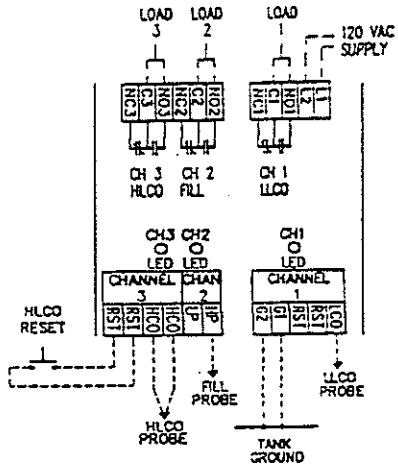
1. Wire only with properly sized and insulated wiring per the National Electric Code (NEC) following the wiring diagram supplied with the boiler.
2. The boiler is completely wired and tested before shipment. No internal wiring is required. Primary power circuit and a separate control circuit are used to power the boiler. Primary power, wire size, and equipment must be rated per NEC. The control circuit power should be connected to the control circuit terminal block, located inside the access door.
3. User should provide a safety switch, employing circuit breakers or fuses, between the main power source and the boiler.
4. Because of their water lines, boilers are susceptible to lightning damage. Industrial type lightning protector should be installed at the electrical service entrance. Check your contractor or electrical dealer for the recommended type of protector for your system.
5. Confirm that the supply voltages match nameplate ratings on the boiler.
6. Be sure all electrical connections, both inside the boiler and in the power supply wiring, are properly tightened and retighten, if required, before energizing the boiler.
7. Substitution of components or modification of the wiring voids the warranty and may lead to dangerous operating conditions.

TYPICAL WIRING DIAGRAMS

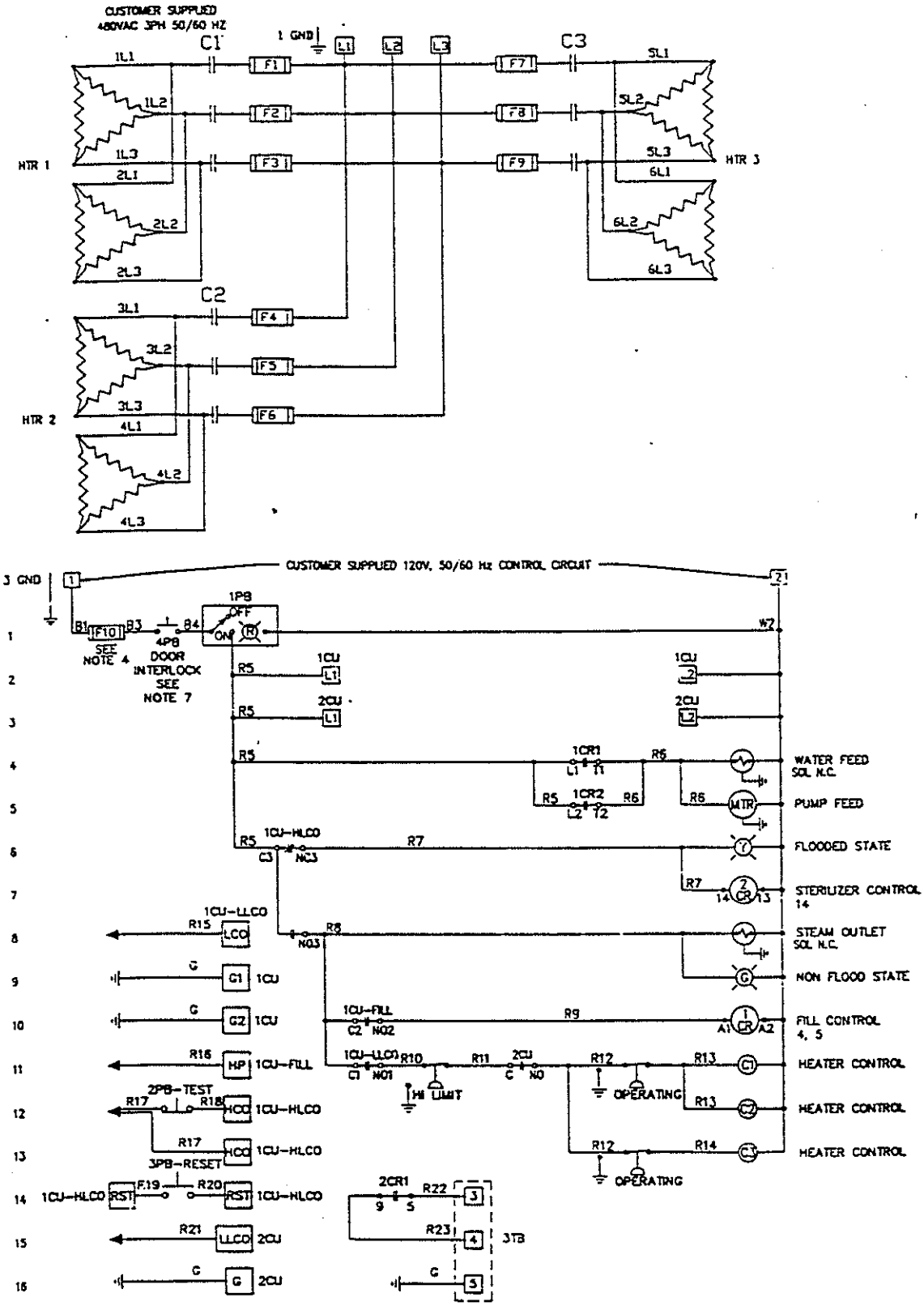
WIRING FOR YOUR SPECIFIC BOILER IS LOCATED ON THE INSIDE OF THE CONTROL CABINET OF THE BOILER.



TYPICAL AUXILLIARY LOW WATER CUT OUT



SOLID STATE LIQUID LEVEL CONTROL



TYPICAL WIRING DIAGRAM

PRE-OPERATION CHECK

GENERAL

1. **STERIS** boilers are supplied with both an operating (See figure 1) and a high limit pressure control (See figure 2). The operating pressure control is used for controlling the operating pressure of the boiler. Boilers 100 kW and larger, have two operating pressure controls. The high limit pressure control (only one on all units) is used to limit the pressure in the boiler. To determine the difference in the controls, the high limit has a manual reset lever on top of the case. Also, the high limit has no differential scale present.
2. On all controls, the pressure adjusting screw on the top of the case sets the desired operating pressure. Turning the screw counterclockwise reduces the pressure setting (CUT OUT). The high limit control should be set at 10 psig above the operating pressure of the boiler, 90 psig maximum.
3. The differential adjusting screw on the operating pressure control is set in the same manner as the pressure adjusting screw. The CUT OUT setting minus the differential setting equals CUT IN pressure of the operating pressure control.

OPERATING PRESSURE CONTROL

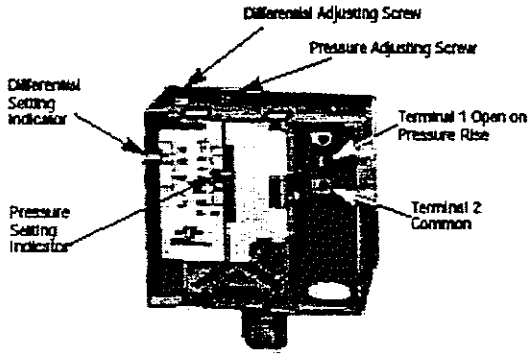


Fig 1.

1. To check operation of the operating pressure, first verify the setting on the control. The setting should be 80 psig. The differential setting should be set at 10 psig. Note that boilers rated 100 kW and larger have two operating pressure controls. Both are to be set at the same pressure.
2. Turn the boiler on and allow it to heat up while observing the pressure gauge. The heater contactor(s) should be energized until the pressure reaches the operating pressure control set point. At that point the contactor(s) will drop out. The contactor(s) should remain off until the pressure in the boiler has dropped to the differential setting.
3. To reset the pressure control, bleed off pressure from the boiler by opening the steam outlet, drain, or blowdown valve. If the pressure gauge indicates operation outside the range, adjust as necessary.

HIGH LIMIT PRESSURE CONTROL

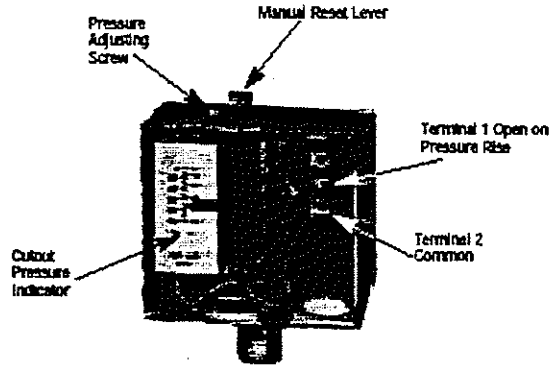


Fig. 2.

1. The high limit control is to be set at 90 psig maximum. The high limit is tested in the same manner as the operating pressure control, except with the operating pressure control set above the setting of the high limit control.

CAUTION: RESET BOTH CONTROLS TO THEIR PROPER SETTINGS AFTER TESTING IS COMPLETE.

2. Adjust the high limit control to 20 psig. Adjust the operating pressure control to 25 psig.
3. Turn the boiler on. The boiler will heat up and build pressure until the setting of the high limit control is reached. At this point the contactor(s) will drop out. Allow pressure to drop in the boiler.
4. The heater contactor(s) should remain de-energized even when the pressure drops below he high limit control setting. When the pressure drops below the high limit pressure setting, the manual reset lever must be pushed to resume operation. Push the reset lever on the high limit control and the contactor(s) should re-energize.
5. After confirming this action, turn the boiler off and reset both the operating pressure control and the high limit control. The operating control should be set to 80 psig and the high limit control should be set to 90 psig.

PRINCIPLES OF OPERATIONS

NOTE: Refer to the wiring diagram preceding this section. Please note that this diagram is for general reference only and that the specific wiring diagram for a particular boiler is located on the inside of the boiler control cabinet.

Each boiler requires both a low voltage power feed for control operation (typically 120 VAC) and a high voltage power feed for heater operation (various voltages). Each boiler has a solid state water level control with a low level cut out (LLCO) probe, a fill (FILL) probe, and a high level cut out (HLCO) probe. Each boiler also has an auxiliary low water cut out control with an auxiliary low water cut out (LWCO) probe.

The probes sense water level by measuring a small current flowing through the water between the probe and the boiler chamber. The water must have a resistivity of no more than 4700 ohms for the LLCO probe to function properly. A small voltage is applied across the shell of the boiler and the probes. When there is water between the probe and the shell, the control interprets the small current between the probe and the shell as water being present. If there is no water between the probe and the shell no current will be sensed, indicating no water is present.

Starting with an empty boiler, with the boiler power switch ON, power is supplied to the solid state water level control (1CU) and the auxiliary low water cut out control (2CU). The LED on the solid state water level control associated with high water level will be ON (1CU-HLCO energized). The FILL probe senses no water and solid state water level control 1CU-FILL contacts close, energizing 1CR relay, powering the water feed solenoid and water pump. An LED on the solid state control associated with this circuit will light.

As water fills the boiler, the LLCO probe and LWCO probes will sense water and provide power to the heater contactors through the Hi Limit and Operating pressure switches. The boiler will start to heat up. The water level will continue to rise and the FILL probe will sense the water. The control will then keep the fill circuit energized for an additional five (5) seconds after which 1CR1 and 1CR2 will drop out turning off the water pump and fill solenoid.

As steam is produced and used the water level in the boiler will drop. When the water drops below the FILL probe, 1CR1 and 1CR2 will close and the boiler will re-fill with water. Again the fill continues for five (5) seconds after the FILL probe senses water.

The boiler will continue heating until the operating pressure switches reach set point, at which point the contactors will drop out. When the pressure in the boiler drops to the differential setting on the pressure switch, the switch will re-activate the contactors. Should pressure exceed the setting on the Hi Limit pressure switch, the Hi Limit switch will open and remove the control voltage to the contactors. Since the Hi Limit switch is a manual reset control, control voltage will not be restored to the contactors until the pressure is reduced and the manual reset button on the Hi limit pressure switch is pressed.

Should the water level rise in the boiler to the HLCO probe and remain for at least 2 seconds, the 1CU-HLCO circuit will be de-energized, which removes power from the steam outlet solenoid valve, 1CR fill relay, and heater contactors. A visual alarm is activated and 2CR relay for remote alarm is activated. A manual reset button, located on the outside the boiler control cabinet, must be pressed to reset the control to normal operation after the water level is lowered.

Should the water level drop below the LLCO probes for at least 3 seconds, the solid state water level control will remove control voltage from the heater contactors by opening 1CU-LLCO contacts.

Should the water level drop below the auxiliary low water cut out probe (LWCO) the auxiliary low water cut out control will remove power from the same circuit (redundant safety control).

Standard units will automatically reset when water level rises above LWCO probe. However, some units have a manual reset for the auxiliary LWCO as required by some local codes. On unit so equipped, the manual reset pushbutton, located on the outside of the control cabinet, must be pushed to reset the heater circuit after the water level has reached the LWCO probe.

Power Outage –

Both the solid state water level control and the auxiliary low water cut out control will ignore a power loss and return to normal operation when power is restored.

Broken wire detection –

HLCO circuit - should either wire to the HLCO probe become disconnected and 2 seconds pass, the HLCO circuit will be de-energized, which removes power from the steam outlet solenoid valve, 1CR fill relay, and heater contactors.

FILL circuit - should wiring to the FILL probe become disconnected the boiler will continue to fill until the HLCO circuit senses an overfill condition.

LLCO circuit - should wiring to the LLCO probe become disconnected the water level control will de-energize the heater contactors.

LWCO circuit - should wiring to the LWCO probe become disconnected the auxiliary water level control will de-energize the heater contactors.

RECOMMENDED START-UP PROCEDURES

1. Close the globe valve on steam outlet side of boiler. (Customer Supplied)
2. Turn on boiler and allow pressure to build up to operating pressure.
3. Only open the globe valve at quarter turns at first, introducing smaller amounts of steam into process. Avoid opening globe valve all at once. This will eliminate the possibility of evacuating the boiler of water caused by the suddenly increased boiling of the water in the vessel as the pressure is reduced. On boilers where constant pressure is not maintained, globe valve should be kept partially closed. This will maintain a constant head on the boiler and help stabilize any fluctuation in boiler water level.
4. Check for leaks in piping, repair as necessary
5. If you have been supplied with a Manual Reset Low Water control as required in some states, the reset button on the control must be pushed before boiler will begin developing pressure. Do not push reset until boiler has filled with water.

PREVENTATIVE MAINTAINENCE

MANUAL FLUSHING/BLOWDOWN

Manual flushing or blowing down your steam boiler is an essential part of unit's operation. It is the best preventive maintenance you can give your boiler and will extend the life of the unit. Make sure a flush or blowdown schedule is established and followed on a daily basis.

If there is a particular problem that applies to your water condition, it may be necessary to increase the frequency of the flushing or blowdown procedure to be followed.

COLD FLUSHING

This procedure is necessary if your drain cannot withstand, or if local codes do not allow, drain discharge at or above 212° F. This procedure flushes water through the boiler after it has cooled down to 140° F.

CAUTION: Wait until boiler pressure gauge indicates "0" pressure and has cooled to 140° F before performing FLUSH procedure.

1. Disconnect high voltage 3 phase power to protect the heaters.
2. Position control power switch to off.
3. Open the boiler drain valve by turning handle counterclockwise 90 degrees.
4. Position control power switch to on. The feed water pump will come on.
5. Flush boiler for at least five minutes until drain water is clear
6. Close drain valve. The boiler will refill with water.
7. Position power switch to off.
8. Reconnect high voltage power.
9. Boiler is now ready for normal use and operation.

BLOWDOWN (HOT)

Warning - Burn Hazard: During this procedure, the boiler piping is hot and water is released under pressure and should be connected to a receiver capable of withstanding 260° F (127° C). To prevent burns, wear protective gear and use caution.

WARNING – BURN HAZARD: Steam and boiling hot water will exit the drain under pressure. Proper safety attire (gloves, eye protection, insulated overall) are necessary.

1. Position control power switch to the on position until approximately 20 psig is indicated on boiler pressure gauge.
2. Disconnect high voltage 3 phase power to protect heaters.
3. Slowly open boiler drain valves by turning the handle counterclockwise 90°.
4. Allow the boiler to blowdown for two to three minutes. The boiler pump will come on during this time.
5. Close drain valve. The boiler will refill with water.
6. Position power switch to off.
7. Reconnect high voltage 3-phase power.
8. The boiler is now ready for normal use and operation.

HEATING ELEMENT, BOILER CHAMBER, AND PROBE CLEANING

WARNING - Burn Hazard: Verify that boiler pressure gauge indicates "0" psig and boiler is below 120° F before servicing

1. Allow the boiler to cool and drain completely. Boiler drain valve to remain open.
2. Lockout/tag-out the 3 phase and 1 phase power source from the boiler at the wall box following an approved procedure.
3. Carefully tag each lead on the heating element terminals of the first element so they can be returned to the original terminals later.
4. Remove the leads from the heating element of the first element. Do not remove the jumper straps from the heating element terminals.
5. Remove the bolts that secure the heating element to the boiler and carefully slide the heating element out of the boiler.
6. Clean the heating element and the inside of the boiler chamber with a wire brush to remove the heavy mineral deposits and scale. Do not use power tools or chipping motion when cleaning heating elements as this may damage the element.
7. Re-install the heating element in the boiler chamber using a new heating element gasket. Alternately tighten the mounting bolts as indicated on the instructions supplied with the new gasket.
8. Re-connect the leads to the heating element terminals.
9. Perform steps 3 through 8 for each additional heating element.
10. Tag each lead on the control probes so they can be returned to the original terminals later.
11. Remove the lead from the probes.
12. Remove the probes and clean with a wire brush or sandpaper.
13. Re-install the probes and probe leads assuring that each lead is reconnected to the correct electrode.
14. Close boiler drain valve.
15. Re-connect 3 phase and 1 phase power source.

STEAM CHAMBER DESCALING/FLUSHOUT USING STERIS DESCALER P-764315-722

1. Remove heavy scale buildup from inside of boiler as described in the preceding section and note approximate amount of overall scale build-up.
2. If your boiler has been supplied with an Automatic Flush and Drain, proceed as follows:
   a. Start the boiler in the normal manner in order to flush out loose sediment.
   b. Immediately after flushing, when boiler fills to its proper operating level, turn boiler off and remove Automatic Flush and Drain relay from its base. Note: It is necessary to by-pass the Automatic Flush and Drain cycle during descaling in order to prevent the unit from flushing out the descaler when the boiler is turned on again.
3. For boilers without Automatic Flush and Drain:
   a. Open boiler manual drain valve and start boiler in normal manner in order to flush out loose sediment.
   b. After approximately 3-5 minutes, close the boiler manual drain valve.
   c. When boiler fills to its proper operating level, turn boiler off.
4. Make sure that the boiler is cool and pressure gauge is at 0 psig.

5. Remove either the pipe plug in the steam outlet discharged line (preferred) or the low water electronic level control probe.
6. Insert funnel into opening and very slowly pour in 10 oz. of STERIS Descaler (P-764315-722) for every gallon of water in the boiler (See table 1). Being careful of fumes and properly venting while pouring.

TABLE 1

Boiler Model No.	Operating Water Capacity
CH02-04	3.0 GAL
CH05-08	7.0 GAL
CH10-14	18.0GAL

7. Re-install pipe plug or low water level control probe.
8. Close the steam outlet valve and allows the descaler solution to remain in the boiler for 60 minutes.
9. Turn boiler on until 5 psig steam pressure shows on boiler pressure gauge.
10. Turn boiler off and let stand for at least ½ hour or until boiler pressure gauge shows 0 psig.
11. For units with Automatic Flush and Drain:
    a. Replace flush and drain relay removed in 2b above.
    b. Turn boiler on in the normal manner and allow boiler to flush for three minutes.
    c. Refill the boiler to normal operating level.
    d. Turn boiler off.
12. For units without Automatic Flush and Drain:
    a. Open the boiler drain valve.
    b. Turn boiler on in normal manner and allow flushing for three minutes.
    c. Close the boiler drain valve.
    d. Refill to normal operating level.
    e. Turn boiler off.
13. Repeat either step 11 (for units with Automatic Flush and Drain) or step 12 (for units without Automatic Flush and Drain) a total of four more times.
14. Boiler is now ready for normal use and operation.

PREVENTATIVE MAINTAINANCE CHECK LIST

Note: Unit must be cold to perform PM, unless blowdown (hot) is required	
STEP	**FREQUENCY**
	(Recommended frequency every two months unless otherwise noted)
PREPARATION FOR PREVENTIVE MAINTENANCE	
Discuss equipment with operators	Each
Follow appropriate safety procedures; Prepare unit for PM	Each
CHAMBER FLUSH/BLOWDOWN/DESCALE	
Flush/ Blowdown unit, whichever is required	Each
Descale	As Required
NOTE: More frequent descaling may be necessary depending on local water quality and frequent of flush/blowdown performed by the customer per recommended maintenance procedures described in the Operator's Manual.	
VALVES	
Verify each hand (ball) valve operates easily, check valve packing for leaks, rebuild or replace as needed.	
Water supply valve	Each
Pressure gauge valve	Each
Water column drain	Each
Blowdown	Each
Replace check valve(s).	2x/yr
Replace safety valve.	1x/yr
Rebuild steam solenoid valve.	2x/yr
Rebuild water solenoid valve.	2x/yr
MISC PIPING COMPONENTS	
Inspect strainer for debris, clean as needed.	Each
Pressure gauge (0-160 PSI) - Verify proper operation. Replace if needed.	Each
Pressure switches – Verify proper setting and operation.	Each
Control	Each
Safety (Check manual reset)	Each
SIGHT GLASS ASSEMBLY	
Check for signs of cracking, leaking.	Each
Replace sight glass, washers and valves.	2x/yr
WATER LEVEL CONTROL SYSTEM	
Verify proper operation.	Each
Clean water level control rods.	3x/yr
FINAL CHECKOUT AND TEST	
Clean dirt and lint from components. Check all writing, terminals and socket connections for damage or fraying. Re-tighten wiring connections as needed.	Each

Verify that unit has proper labels (caution, warning).	Each
Replace any blown fuses or burned out lamps as needed.	Each
Check fuses and fuse clips for signs of deterioration, arcing.	Each
Check heater contractors for signs of arcing.	Each
Start up boiler. Verify correct water fill level, operating pressure, come-up time, etc.	Each
Test flood alarm system.	Each
Reinstall any panel or cover removed. Check area to insure removal of all materials used during inspection.	Each
Notify customers that PM inspection is complete.	Each

STERIS STAND ALONE BOILER TROUBLE SHOOTING CHART

Control power light off.	Control Fuse blown. Control power off.	Check and/or replace control fuse. Check breaker or main power feed.
Boiler doesn't run. Control power light on.	Flood alarm enabled. High limit pressure switch tripped.	Reset flood alarm. Reset manual pressure switch. Check switch setting. Adjust to 10 psig higher than operating control switch setting. Adjust manual reset switch differential to minimum setting. If switch continues to trip may be due to faulty control switch or faulty heater contactor.
Intermittent false flood alarms, boiler water level normal.	Loose connections on dual lead wires to flood probe. Boiler priming (foaming) caused by high alkalinity and dissolved solids in the boiler water (Soft water). High level probe in wrong location. Unit has antiflood probe in top of tank or in "Y" branch at steam outlet.	Check all terminations and lead wires on the flood control board and probe. Provide for daily boiler blowdown or increase frequency of drain and flush cycle to reduce contamination in boiler water. Check for proper location of flood probe. Probe should not be in tank or in steam outlet line piping. Order side arm water column kit to remove flood probe from steam outlet. P755716-180 for 10-20 kW, P755716-181 for 30-75 kW, P775716-182 for 100-180 kW.
Pump short cycles. Boiler fills erratically.	Inductive signal from power leads causing control to short cycle.	Separate probe lead wires (blue & yellow) on water level probe to water level control board from other wires in the harness assembly.
Threaded connection leak after several weeks of operation.	Expansion and contraction of piping loosens threaded connections. High alkalinity in boiler water attacks pipe sealant and metal.	Retighten threaded joints. Disassemble re-dope pipe threads and reassemble. Maintain boiler water quality with proper blowdown and drain and flush cycles (soft water). Increase frequency of boiler maintenance.
Frequent or continuous flood alarms, boiler actually flooded.	Loose connection on water level probe. Damaged or overloaded motor starter relay (stuck contacts).	Check all connections and wiring to water level control board and probe. Check motor relay contacts for burning or arcing. Check feed water pressure and supplies (20-50 psig dynamic under load). Make sure pump motor is not stalling at start up, overloading the relay contacts. Replace 10A/13A relay with 15 A relay P764322-763.

		Separate probe lead wires on water level probe to water level control board from wires in the harness assembly.
	Faulty water inlet solenoid valve.	Rebuild solenoid valve.
	Scale formation on water level control probe.	Clean probe. Improve maintenance on boiler by more frequent blow down and descaling. Check water hardness, should be 0-7 grains maximum.
	Faulty water level control board.	Replace water level control board.
	Water has insufficient conductivity to activate control probe.	Check water resistance (conductance). Maximum resistance is 26K ohms.
	Water level probe missing.	Check water level probe inside tank to make sure it is in place. Check isolator tube for corrosion or physical damage.
	Condensate from steam line running back into boiler.	Check for proper steam traps in steam line to remove or control condensate. Install check valves in steam lines on boilers operated in parallel.
Pump starts (power) but doesn't run or fill.	Pump damaged or seized.	Check to see that the pump is a high temperature model.
	Check valves leaking steam back into pump.	Provide double check valves in the feed water piping between the pump and the boiler tank.
	Water supply line pressure too low.	Check feed pressure and supply. Should be 20-50 psig dynamic (under load).
No water in sight glass. Pump doesn't start.	Shorted water level probe.	Check lead wires and terminal connection on probe. Make sure terminal is not shorted to the sheet metal enclosure (top panel). Check probe rod inside tank. Probe rod may be shorted to the isolater tube inside the boiler tank.
	Boiler flood control tripped.	Reset control. Refer to corrective action above for actual flood condition.
	Water level control board inoperative.	Functionally check control board. Manually activate probe circuit using jumper wires and observing control relay functions.
	Motor or pump failure.	Check pump and motor for proper operation.

Pump noisy.	Pump cavitating, water supply line pressure too low.	Check feed water pressure and supply. Inlet pressure should be 20-50 psig with adaquate flow.
	Pump and motor misaligned or piping to pump resonating sheet metal adjacent cabinet.	Check pump and motor alignment. Check piping and panels for resonance. Check flow restrictor on outlet side of pump.
	Foreign material in pump.	Check strainer and piping for any obstructions or blockage.
Sight glass empty. Boiler functioning normally.	Sight glass valves closed.	Check sight glass valves and open if necessary.
	Sight glass nozzles and valves plugged with deposits.	Disassemble and clean all sight glass and side arm piping.
Sight glass etched, short life.	High alkalinity (pH 10+) in boiler.	Provide for daily boiler blowdown or increase frequency of drain and flush cycle to reduce contamination in boiler water.
Heater gasket leaks after a short period of operation.	Improper or insufficient bolting.	Check bolting. Bolts must be tightened evenly. Do not exceed 200 inch-pounds of torque.
Upper element have short life.	Boiler feed water or feed water controls not functioning correctly.	Check boiler feed water and level controls. Check for excessive foaming and priming which can expose upper elements. Maintain boiler water quality with proper blowdown and drain and flush cycles.
Lower elements have short life.	Boiler water contaminated or has high alkalinity, attacking and corroding element sheath (soft water).	Maintain boiler water quality with proper blowdown and drain and flush cycles. Increase frequency of boiler maintainance.
All elements have short life.	Excessive scale build up on elements (Hard water).	Maintain boiler water qualtity with proper blowdown (hard water). Increase frequency of boiler maintainance. Consider treating or softening the boiler feed water to reduce scaling.
	Low water cutoff faulty.	Check low water level probe for scaling. Clean as required. Check water level control board for proper operation.
No water in sight glass, contactor(s) chattering.	Water feed system inoperative. Contactor(s) cycling on low water cutoff.	Check feed system. Check water pressure and flow. Check probe rod and wiring. Probe may be shorted to the isolator tube inside the boiler.
Steam pressure fluctuates dramatically under load.	Restrictor in steam line too small.	Check restrictor size.
	Boiler too small for load.	Check steam load and verify capacity requirements.

REPLACEMENT PARTS

VALVES AND GAUGES

½" BALL VALVE, WATER SUPPLY	P764323-514
¼" BALL VALVE, PRESSURE GAUGE	P764323-428
¾" BALL VALVE, WATER COLUMN DRAIN	P764316-938
1" BALL VALVE, BLOW DOWN	P764323-429
PRESSURE GAUGE, 0-160 PSIG	P750467-091
PRESSURE GAUGE, 0-100 PSIG, LIQUID FILLED	P764325-974
SOLENIOD VALVE, ¾" NPT, STEAM	P101006-806
*REPAIR KIT	P764324-417
SOLENOID VALVE, 1" NPT, STEAM	P764323-703
*REPAIR KIT	P117951-000
SOLENOID VALVE, ½" NPT, WATER	P764323-319
*REPAIR VLAVE	P764323-599
CHECK VALVE, ½" (also VACUUM BREAKER)	P764320-492
VALVE, DRAIN, SIGHT GLASS	P764326-712

GAUGE GLASS ASSEMBLIES

GAUGE GLASS VALVE SET	P764323-512
GUARD RODS (4 REQ'D.) CH02 THRU CH04	P764323-700
GUARD RODS (4 REQ'D.) CH05 THRU CH08	P764323-452
GUARD RODS (4 REQ'D.) CH10 THRU CH14	P764323-453
GAUGE GLASS GASKETS	P764326-231
* SIGHT GLASS, 6-3/4"	P764328-920
* SIGHT GLASS, 7"	P764324-885
* SIGHT GLASS, 8"	P754031-091
* SIGHT GLASS, 9 "	P764324-700
* SIGHT GLASS, 9-1/8"	P764325-491
* SIGHT GLASS, 10"	P754032-091
* SIGHT GLASS, 11"	P764324-701
* SIGHT GLASS, 11-1/8"	P764325-492
* SIGHT GLASS, 12"	P075424-091
* SIGHT GLASS, 13"	P764326-542
* SIGHT GLASS, 13-1/8"	P764325-493
WASHER, FRICTION	P764326-361

* To determine correct gauge glass length, measure the distance between the centerline of the upper and lower sight glass valves and subtract 2".

SAFETY VALVES

100 PSIG ½", CH02 THRU CH08	P075421-091
100 PSIG ¾", CH10 THRU CH14	P077320-091

PRESSURE CONTROLS

PRESURE CONTROL, OPERATING, 10-100 PSIG	P764323-470
PRESSURE CONTROL, HI-LIMIT, MANUAL RESET	P764323-471
SIPHON TUBE FOR PRESSURE CONTROLS	P764323-476

WATER FEED

PUMP AND MOTOR, 30 kW THRU 75 kW	
* MOTOR ONLY, 1/3 HP	P764323-489
PUMP ONLY, 1.7 GPM	P764319-902
CLAMP	P764323-491
WATER INLET FLOW RESISTOR, 2 GPM	P046996-091
PUMP AND MOTOR, 100 kW THRU 180 kW	
* MOTOR ONLY, 1/2 HP	P764326-373
PUMP ONLY, 3.2 GPM	P764323-486
CLAMP	P764323-491
WATER INLET FLOW RESISTOR, 3.5 GPM	P764326-193
STRAINER, ½" NPT	P764323-482
HOSE ASSEMBLY, 18" LONG	P764323-493
HOSE ADAPTER, 3/8" NPT, SWIVEL	P764323-495
HOSE ADAPTER, ½" NPT, SWIVEL	P764323-496

* **NOTE:** Originally, 10 kW through 75 kW units used ¼ HP motor and 100 kW through 180 kW units used 1/3 HP motor.

CONTROL

WARRICK SERIES 16 WATER LEVEL CONTROL	
BOARD, (Before Date Code 001IP)	P764326-884
REPLACEMENT RELAY	P764326-887
CURTIS DLA WATER LEVEL CONTROL BOARD	
(Before Date Code 001IP)	P764323-558
REPLACEMENT RELAY	P764322-763
WARRICK ANTI-FLOOD CONTROL BOARD	
(Before Date Code 001IP)	P764323-552
RELAY, PLUG–IN, ANTI- FLOOD CONTROL	
(After Date Code 001IP)	P764323-553
RELAY, CONTROL	
(Before Date Code 001IP)	P764323-557
RELAY, HEAVY DUTY, 220 V PUMP	P041293-091
WARRICK WATER LEVEL / ANTI –FLOOD /	
CONTROL BOARD	
(After Date Code 001IP)	P764326-194
RELAY – LAVADO	
(After Date Code 001IP)	P764326-233
AUXILLIARY LOW WATER CUT-OFF BOARD	P764325-530
(Warrick Series 26)	
WATER LEVEL CTRL SPARK PLUG ELECTRODE	
CH02 THRU CH04	P755716-256

WATER LEVEL CTRL SPARK PLUG ELECTRODE	
CH05 THRU CH08	P755716-257
WATER LEVEL CTRL SPARK PLUG ELECTRODE	
CH10 THRU CH14	P755716-258
HEATER SPARK PLUG ELECTRODE	
CH02 THRU CH04	P755716-257
HEATER SPARK PLUG ELECTRODE	
CH05 THRU CH08	P755716-258
HEATER SPARK PLUG ELECTRODE	
CH10 THRU CH 14	P755716-260
ALWCO SPARK PLUG ELECTRODE	
CH05 THRU CH08	P755716-259
ALWCO SPARK PLUG ELECTRODE	
CH10 THRU CH14	P755716-261
ELECTRODE, SPARK PLUG, ANTI- FLOOD	
(After NB – 5424)	P764325-503
ELECTRODE, SPARK PLUG, ANTI -FLOOD	
(Before NB- 5424)	P764323-515
BOOT, ELECTRODE	P764326-926

MISCELLANEOUS PARTS

ON-OFF SWITCH WITH PILOT LIGHT	P764323-522
FUSE CONTROL CIRDUIT, 15 AMP (BOX OF 5)	P764323-523
FUSE CONTROL CIRDUIT, 1-1/4 AMP (BOX OF 5)	P764317-837
FUSE, TRANFORMER, 6/10 AMP (BOX OF 10)	P764326-874
CONTROL CIRCUIT TERMINAL BLOCK, 4 POLE	P764323-538
CONTROL CIRCUIT FUSE HOLDER	P764323-525
PUSH BUTTOM, N.C.	P764323-326
PUSH BUTTON, N.O. After 1/93	P078481-091
DOOR SWITCH, INTERLOCK	P764325-508
PILOT LIGHT, AMBER	P764323-328
PILOT LIGHT, GREEN	P764323-329
TRANSFORMER, 220/480 VOLT – 120 VOLT	P764326-132
ISOLATOR TUBE, CH02 THRU CH04	P764323-338
ISOLATOR TUBE, CH05 THRU CH08	P764324-730
ISOLATOR TUBE, CH10 THRU CH14	P764324-732
HEATER WIRE # 6	P764326-679
HEATER WIRE # 8	P764326-680
HEATER WIRE # 10	P764326-681
TERMINAL, HEATER WIRE # 6	P764326-885
TERMINAL, HEATER WIRE # 8	P764327-768
TERMINAL, HEATER WIRE # 10	P764326-920

CONTACTORS

FUSABLE CONTACTORS	
30 AMP W/ 35-60 AMP, 600 VOLT BLOCK	P764323-432
40 AMP W/ 35-60 AMP, 600 VOLT BLOCK	P764323-433
50 AMP W/ 35-60 AMP, 600 VOLT BLOCK	P765323-434

NON-FUSABLE CONTACTORS

40 AMP, 120 VOLT, 2 POLE	P764323-334
40 AMP, 120 VOLT, 3 POLE	P759746-001
40 AMP, 120 VOLT, 4 POLE	P764323-336
50 AMP, 120 VOLT, 2 POLE	P764323-335
50 AMP, 120 VOLT, 3 POLE	P759747-001
50 AMP, 120 VOLT, 4 POLE	P764323-337
60 AMP, 120 VOLT, 3 POLE	P759748-001
75 AMP, 120 VOLT, 3 POLE	P764323-694

POWER FUSES AND FUSE BLOCKS

40 AMP, 600 VOLT (BOX OF 10)	P764317-820
45 AMP, 600 VOLT (EA.)	P764323-441
50 AMP, 600 VOLT (EA.)	P764320-434
60 AMP, 600 VOLT (EA.)	P764323-443
70 AMP, 600 VOLT (EA.)	P764325-570
80 AMP, 600 VOLT (EA.)	P764325-571
FUSE BLOCK, 0-60 AMP, 600 VOLT	P150474-521
FUSE BLOCK, 61-100 AMP, 600 VOLT	P764325-572

POWER TERMINAL BLOCKS

3 POLE, 115 AMP, 1 LINE CIRCUIT, 1 LOAD CIRCUIT	P765323-445
3 POLE, 175 AMP, 1 LINE CIRCUIT, 4 LOAD CIRCUIT	P764323-446
3 POLE, 335 AMP, 1 LINE CIRCUIT, 4 LOAD CIRCUIT	P764323-447
3 POLE, 335 AMP, 1 LINE CIRCUIT, 8 LOAD CIRCUIT	P764323-448

HEATER ELEMENTS

SINGLE PHASE

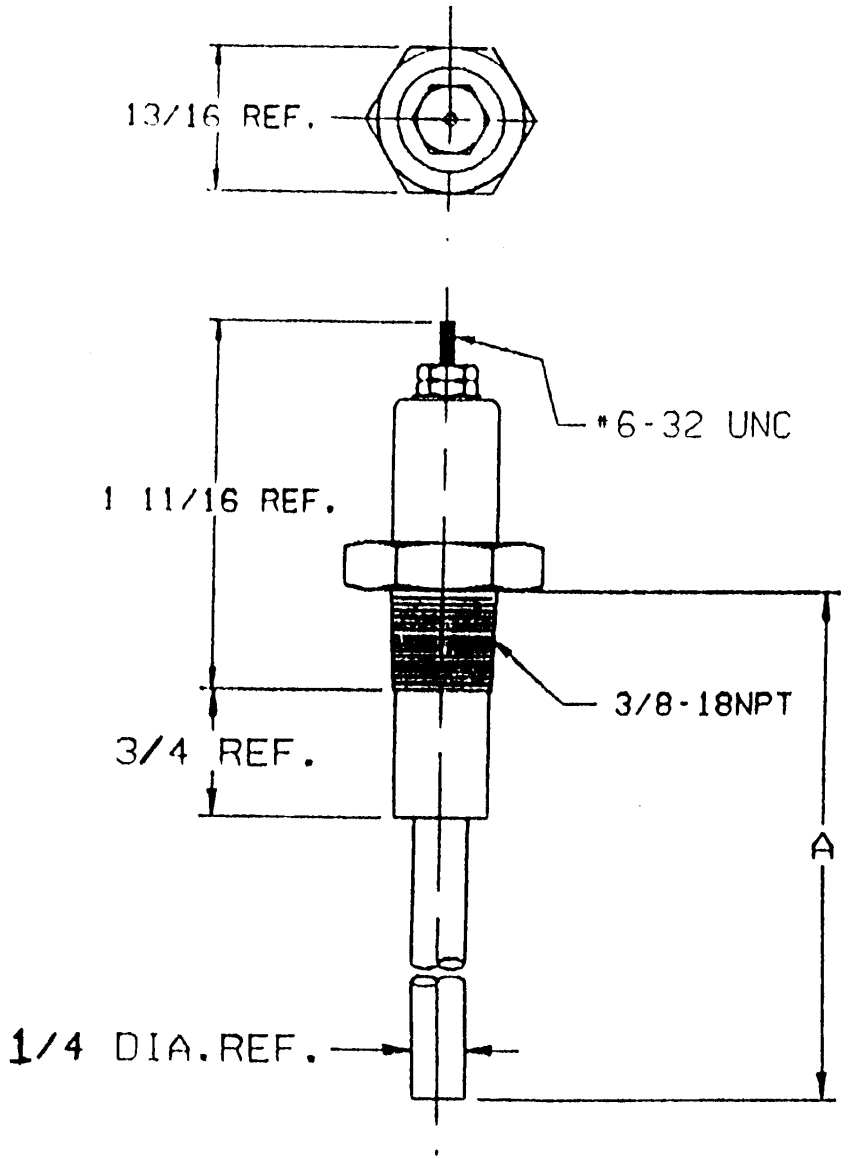
10 kW, 208 VOLT	P764323-400
10 kW, 240 VOLT	P764323-402
10 kW, 480 VOLT	P764323-404
15 kW, 208 VOLT	P764323-406
15 kW, 240 VOLT	P764323-408
15 kW, 480 VOLT	P764323-410
20 kW, 208 VOLT	P764323-412
20 kW, 240 VOLT	P764323-414
20 kW, 480 VOLT	P764323-416
30 kW, 240 VOLT	P764326-923

THREE PHASE

10 kW, 208 VOLT	P764323-401
10 kW, 240 VOLT	P764323-403
10 kW, 480 VOLT	P764323-405
15 kW, 208 VOLT	P764323-407
15 kW, 240 VOLT	P764323-409
15 kW, 480 VOLT	P764323-411

20 kW, 208 VOLT (20KW UNITS ONLY)	P764323-413
20 kW, 240 VOLT (" ")	P764323-415
20 kW, 480 VOLT (" ")	P764323-417
20 kW, 208 VOLT	P764324-886
20 kW, 240 VOLT	P764323-424
20 kW, 380 VOLT	P764324-887
20 kW, 480 VOLT	P764323-425
30 kW, 208 VOLT	P764323-418
30 kW, 240 VOLT	P764323-419
30 kW, 380 VOLT	P764325-448
30 kW, 480 VOLT	P764323-420
34 kW, 208 VOLT	P764323-655
34 kW, 240 VOLT	P764323-657
34 kW, 380 VOLT	P764324-731
34 kW, 415 VOLT	P734626-875
34 kW, 480 VOLT	P764323-691
34 kW, 600 VOLT	P764329-304
37.5 kW, 208 VOLT	P764323-421
37.5 kW, 240 VOLT	P754323-422
37.5 kW, 380 VOLT	P764326-083
37.5 kW, 415 VOLT	P764328-077
37.5 kW, 480 VOLT	P764323-423
40 kW, 208 VOLT	P764324-889
40 kW, 240 VOLT	P764325-065
40 kW, 380 VOLT	P764326-866
40 kW, 415 VOLT	P764326-867
40 kW, 480 VOLT	P764323-715
45 kW, 208 VOLT	P764326-541
45 kW, 240 VOLT	P764323-426
45 kW, 380 VOLT	P764328-076
45 kW, 415 VOLT	P764328-075
45 kW, 480 VOLT	P764323-427
HEATER GASKET, CH02 – CH04	P764323-527
HEATER GASKET, CH05 – CH14	P764323-594
HEATER BOLT, EACH	P764323-643
HEATER FLANGE, (BLIND) CH02-CH04	P764323-526
HEATER FLANGE (BLIND) CH05-CH14	P764325-699

FOR HEATER APPLICATION SEE CHART



AMSCO P/N	A	FOR USE ON
755716-254	5 7/8	CHS PUMP CONTROL
755716-255	7	CHS HTR CONTROL
755716-256	8 1/2	CES-C 5/20KW PUMP
755716-257	9 3/8	CES-C 5/20KW HTR, 30/75KW PUMP
755716-258	10 7/16	CES-C 30/75KW HTR, 100/180KT PUMP
755716-259	11	CES-C 30/75KW AUX.LWCO
755716-260	11 1/2	CES-C 100/180KW HTR
755716-261	13 1/2	CES-C 100/180KW AUX.LWCO

Chromalox®

Installation, Operation
and
RENEWAL PARTS IDENTIFICATION

SERVICE REFERENCE	
4	GENERAL
	PQ443
	161-300574-004
DATE NOVEMBER, 1992	

Boiler and Steam Generator Heating Element Replacement

WARNING: ***Hazard of electric shock, can cause severe personal injury or death. Disconnect power at source before servicing.***

WARNING: ***Hazard of severe personal injury. Allow boiler to cool and pressure to drop to zero before servicing.***

WARNING: ***Provision should be made to prevent water damage from any eventual leaking of boiler or components. Install near a floor drain.***

1. Before proceeding with heating element replacement review causes of element failure on reverse side of this sheet to determine if items other than element replacement need to be serviced.
2. Check that boiler is properly drained. Note wire locations disconnect wires, and remove failed heating element from boiler.
3. Boilers with multiple heater elements examine condition of other elements in the boiler. If heavy solids build-up is evident or elements are distorted, replace all elements effected.
4. Examine heater element bolts. If these are corroded, replace with ASME grade B-7 bolt of equivalent size.
5. Clean flange face on boiler carefully so as to maintain smooth gasket surface.
6. Install gasket over heater element and insert element into boiler when installing heating element gasket do not use any liquid sealer etc. Install dry.
7. Shown below is the bolt tightening sequence required when replacing heating elements. All bolts finger tight should be sequentially tightened (Fig. 1, Fig. 2 & Fig. 3) in two (2) stages. First to 100 in/lb. then to a final torque of 200 in/lb.

	Sequence
Fig.1 - Eight (8) bolt flange (5¾ Sq.)	1-5-3-7-2-4-6-8
Fig. 2 - Six (6) bolt flange (4½ Sq.)	1-3-5-6-2-4
Fig. 3 - Four (4) bolt flange (2½ Sq.)	1-3-2-4

8. Reconnect wiring to heater element and follow boiler startup procedures. Check that required electrical clearance between terminals is maintained.

Note: Heater element bolts should be retorqued after generator has been operating several hours at working pressure.

WARNING: ***Retorquing should be done when unit is cold and with power disconnected at source.***

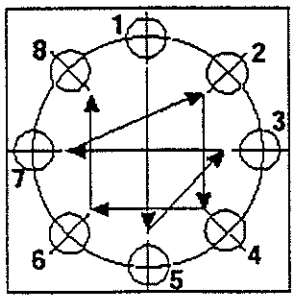


Figure 1

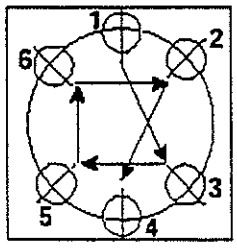


Figure 2

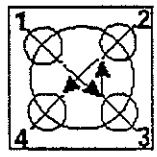


Figure 3

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IMMERSION HEATER FAILURE CAUSES

Heater Element Condition	Probable Cause
1. Water leakage at heater flange	1. Heater bolts improperly tightened. Refer to flange tightening instructions. 2. Debris on heater flange or generator flange surface. Clean prior to installation. 3. Heater bolts not retorqued after initial operation. Refer to flange tightening instructions.
2. Water leakage at heater element to flange junction.	1. Faulty weld or braze on element to flange connection or corrosion. 2. Verify water is not exiting through heater terminal. Normally seen in condition #5.
3. Burned wiring connections	1. Loose wire connections. Tighten properly after inspection. 2. High resistance in wire connection due to oxidation. Clean wires before reconnecting to element. Replace if necessary.
4. Heater element has open circuit. (Element looks OK but Ohmmeter check shows infinite resistance).	1. Element has open circuit due to normal wear and tear to end life. 2. If generator is undersized for its application, heaters will be over worked and reach end of life sooner. 3. Element has been overheated due to excessive scale build up. The scale acts as an insulator retarding heat transfer to the water. Short life will result. If significant scale is observed on element, this would indicate need for more frequent blowdown or descaling. 4. Wrong voltage supplied to element. 5. Element not totally immersed in water. This causes a localized hot spot which melts the wire inside the element. Cause of problem is fault in water level control system. Elements damaged in this manner may be distorted. Repair and verify operation of the level control prior to restarting the heater.
5. Heater element has developed a ground fault. When this occurs, a hole may be formed in the sheath material, allowing water to enter the element.	1. Corrosion of heater element sheath-use of corrosive descaler compounds will etch sheath. Use only approved descaler to remove scale. 2. Element has overheated due to excessive scale build up. This can cause localized hot spot which sometimes arcs thru insulation and the ground metal sheath. More frequent blowdown and/or descaling is needed. 3. Element not totally immersed in water. This causes a localized hot spot which produces a hole in sheath. Cause of problem is fault in water level control system. Elements damaged in this manner may be distorted. 4. Excess vibration. Vibration could cause rubbing of elements wearing a hole in the sheath. Vibration could be caused by a large machinery nearby. 5. Wrong voltage supplied to element.

WARRANTY AND LIMITATION OF REMEDY AND LIABILITY

Chromalox warrants only that the Products and parts manufactured by Chromalox, when shipped, and the work performed by Chromalox when performed, will meet all applicable specifications and other specific product and work requirements (including those of performance, if any, and will be free from defects in material and workmanship under normal conditions of use. All claims for defective or nonconforming (hereinafter called defective) Products, parts or work under this warranty must be made in writing immediately upon discovery, and in any event, within one (1) year from delivery, provided, however all claims for defective Products and parts must be made in writing no later than eighteen (18) months after shipment by Chromalox. Defective and nonconforming items must be held for Chromalox's inspection and returned to the original f.o.b. point upon request. THE FOREGOING IS EXPRESSLY IN LIEU OF ALL OTHER WARRANTIES WHATSOEVER, EXPRESS, IMPLIED AND STATUTORY, INCLUDING, WITHOUT LIMITATION, THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE.

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Upon Buyer's submission of a claim as provided above and its substantiation, Chromalox shall at its option either (i) repair or replace its Products, parts or work at the original f.o.b. point of delivery or (ii) refund an equitable portion of the purchase price.

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Chromalox®
PRODUCT SERVICE
2150 N. RULON WHITE BLVD., OGDEN, UT 84404
Phone: 1-800-368-2493

WIEGAND INDUSTRIAL DIVISION
EMERSON ELECTRIC CO.
EMERSON.

99-0163
TA - Y2 - EF
Litho in U.S.A.

CHROMALOX

Installation of Level Control Part No. 323-300033-035

CAUTION: This bulletin should be used by experienced personnel as a guide to the installation of the Part No. 323-300033-035 Level Control. Selection or installation of equipment should always be accompanied by competent technical assistance. You are encouraged to contact Chromalox or one of its local sales representatives for additional information.

SPECIFICATIONS:

ELECTRONICS MODULE: Solid state components enclosed in a molded ABS housing.
CONTACT DESIGN: SPDT (1 form C): One normally open (N.O.) and one normally closed (N.C.), set of non-powered contacts per channel.
CONTACT RATINGS: 5A @ 120, 240 VAC resistive, 1/3 HP @ 120, 240 VAC.
CONTACT LIFE: Mechanical - 5 million operations. Electrical - 100,000 operations minimum at rated load.
SUPPLY VOLTAGE: 120 VAC, plus 10% minus 15%. 50/60 Hz.
SUPPLY CURRENT: 120 VAC - Three relays energized - 32mA.
SECONDARY CIRCUIT: 12 VAC RMS voltage on probes, 1.5mA current.
SENSITIVITY: FILL and HLCO probes - 26,000 ohms. LLCO probe 4,700 ohms maximum specific resistance.
TEMPERATURE: -40 to 150 degrees F. ambient.
TERMINALS: Removable terminal strips containing size 6 pan head screws with clamping plates. Will accept up to (2) - 14 AWG wires.
TIME DELAYS: HLCO probe - 2 seconds on rising level, fill probe (H.P.) - 5 seconds on rising level, LLCO probe - 3 seconds on falling level. Time delay tolerance + - 1 second.
LISTING: Entire control carries U.L. 508 motor controller recognition and U.L. 353 limit control listing.

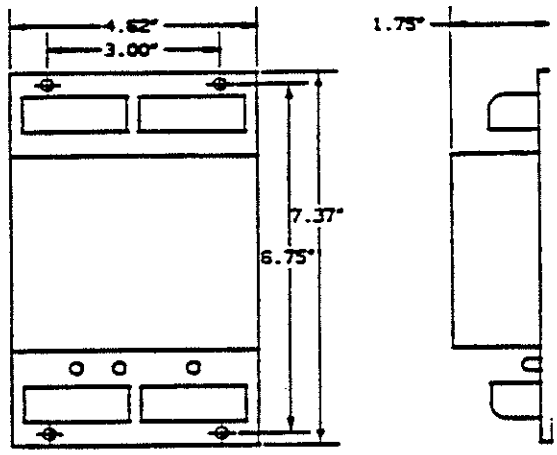
INSTALLATION:

1. Install module using four (4) #6 or #8 metal screws.
2. Wire the control with 14-16 AWG, THHN or MTW wire, per the wiring diagram. N.E.C. and local codes should be followed.

REMOVAL AND REINSTALLATION:

1. To remove the terminal blocks, pry gently with a small screw driver between the terminal block and its mounting base. This operation may be facilitated by gently lifting up on the terminal block at the same time.
2. Remove the four (4) mounting screws and control.
3. Re-install control (less terminal blocks) and snap existing terminal blocks in place.

Dimensional Diagram



OPERATION

The Chromalox Level Control (323-300033-035) performs three independent functions: The HLCO terminal provides high level, anti-flood protection. The H.P. terminal provides a timed fill cycle for the feedwater device. The LLCO terminal provides the low level cutoff protection.

HLCO FUNCTION: Should a high level condition occur and 2 seconds pass, the relay associated with the HLCO terminal will de-energize and lock out (LED will be off). The relay will remain locked out until the level recedes below the probe and the normally open, high level reset pushbutton is depressed (LED will be on).

The HLCO channel provides broken wire detection to the HLCO probe. Should either wire connected to the HLCO probe become disconnected and 2 seconds pass, the relay associated with that channel will de-energize and lock out (LED will be off). The relay will remain locked out until the wires are reconnected and the HLCO reset pushbutton is depressed (LED will be lit). NOTE: For proper operation, two (2) wires must be utilized for the control to HLCO probe connections. Consult wiring diagram for more information.

If either of the ground/reference wires (G1 or G2) breaks or becomes disconnected the HLCO relay will immediately de-energize and lock out (LED will be off). The relay will remain locked out until the ground/reference wires are reconnected and the HLCO reset pushbutton is depressed (LED will be lit).

The HLCO channel provides power outage protection. The control will ignore a power loss and will return to normal operation when the power comes back on. If, however, the level has risen to the HLCO probe the relay will de-energize (LED will be off) and lock out. The control will remain locked out until the level recedes below the HLCO probe and the normally open pushbutton is depressed.

FILL FUNCTION: When the level recedes below the H.P. (fill) probe the relay will energize to activate the feedwater device, filling the boiler (LED will be lit). The boiler will continue to fill until the level rises to the H.P. probe and 5 seconds pass. The relay will then de-energize cutting off the feedwater device (LED will be off). Note: If the water level is on the H.P. probe at power up, the relay associated with the H.P. probe will immediately de-energize shutting off the feedwater device.

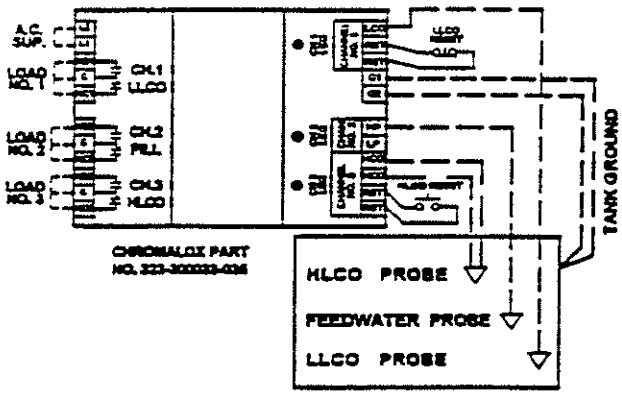
Should ground wire G1 break or become disconnected, the fill relay will energize turning on the feedwater device. The fill relay will remain energized until the following three (3) conditions are met: 1) The wire is reconnected. 2) The water is on the H.P. probe. 3) Five (5) seconds have passed.

LLCO FUNCTION: Should the level recede below the LLCO probe and 3 seconds pass, the relay associated with the LLCO terminal will de-energize and lock out (LED will be off). The relay will remain de-energized until the level is restored to the LLCO probe and the normally closed pushbutton is depressed (LED will be on).

The LLCO channel provides power outage protection. The control will ignore a power loss and will return to normal operation when the power comes back on. If, however, the level has receded below the LLCO probe upon power up the relay associated with this channel will de-energize (LED will be off) and lock out.

Should the ground wire G1 break or become disconnected, the LLCO relay will de-energize (LED will be off). The relay will remain de-energized until the wire is re-connected and the normally closed pushbutton is depressed.

Wiring Diagram



Form 462-A 12/93

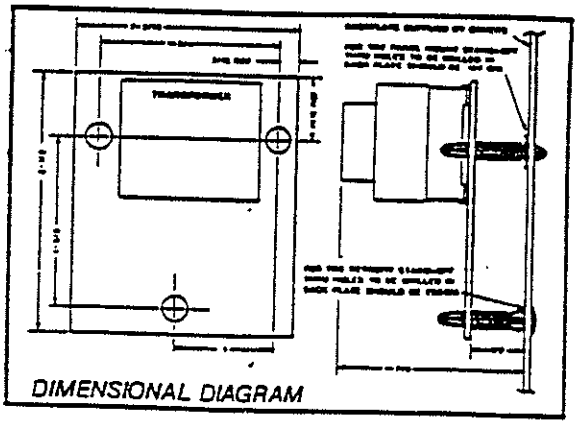
WARRICK CONTROLS

INSTALLATION OF WARRICK SERIES 26 CONTROLS

This bulletin should be used by experienced personnel as a guide to the installation of series 26 controls. Selection or installation of equipment should always be accompanied by competent technical assistance. We encourage you to contact Warrick Controls, Inc., or its local representative if further information is required.

SPECIFICATIONS

CONTROL DESIGN: Open circuit board design
CONTACT DESIGN: SPDT (1 form C): One normally open (N.O.) and one normally closed (N.C.) non-powered contacts.
CONTACT RATINGS: 10A @ 120, 240 VAC resistive (120 F), 1A @ 120, 240 VAC resistive (150 F), 1/3 H.P. @ 120,240 VAC (120 F).
CONTACT LIFE: Mechanical- 5 million operations. Electrical - 100,000 operations minimum at rated load.
SUPPLY VOLTAGE: 120, 240 OR 24 VAC models: plus 10% minus 15% 50/60 HZ. 208/240 model: 187 Vmin. to 255 Vmax. VAC 50/60 HZ.
SUPPLY CURRENT: Relay energized 4.4 VA.
SECONDARY CIRCUIT: 12 VAC RMS Voltage on probes. 1.5 milli-amp Current.
SENSITIVITY: Models operate from 0-26K ohm maximum specific resistance.
TEMPERATURE: -40 to 150 degrees F. ambient.
TERMINALS: Probe connections 3/16" spade: Line and Power Connections 1/4" spade.
TIME DELAYS: Standard - LLCO probe, 3 seconds on lowering level.
LISTINGS: U.L. limit control recognition (353). 240 and 208 volt units are not U.L. limit control recognized.

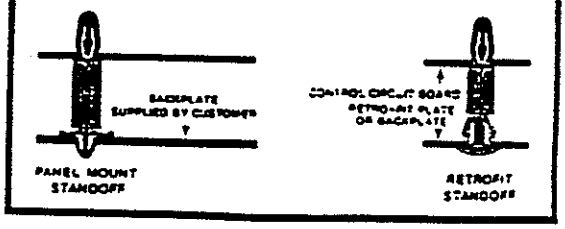


DIMENSIONAL DIAGRAM

INSTALLATION

1) Drill 3 (three) .187 dia. holes in customer supplied backplate using stick on template supplied with control. Standard standoffs are designed for backplate thickness of .062 (1/16"). Standoffs are available for backplates of .125 (1/8") nominal thickness. If retro-fit plate standoffs are used, drill 3 (three) .250 dia. holes in proper location.
2) Install 3 (three) standoffs onto backplate. Install circuit board onto standoffs by pushing down on circuit board at outer edges of all four corners. Use both hands to slide board onto standoffs until standoffs lock. CAUTION: Do not overflex circuit board during installation. Do not push down on transformer or relays during installation. See sketch for proper installation. Install control in appropriate enclosure.
3) Wire control per diagram, following N.E.C. and local codes. Use appropriately sized spade terminals.

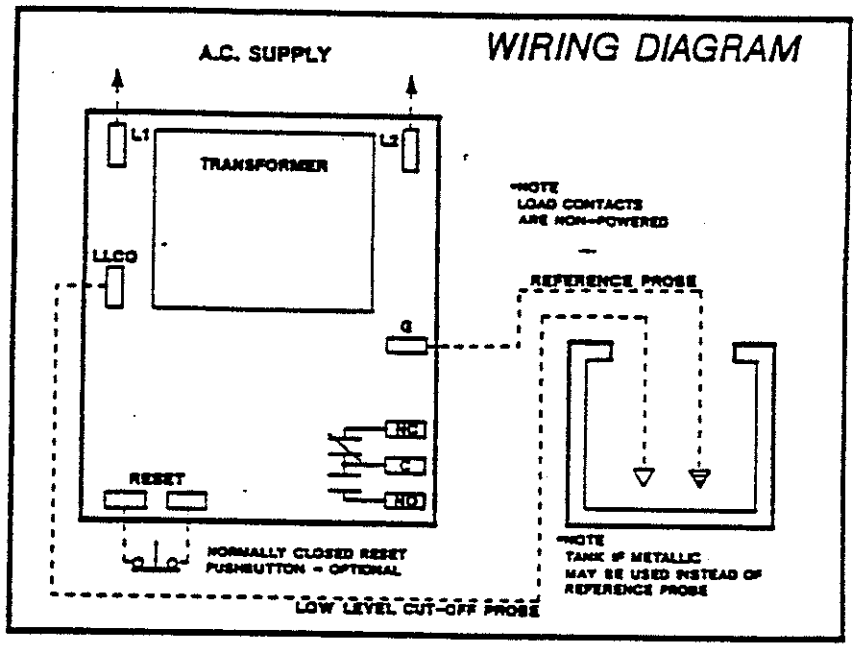
STAND–OFF STYLE DIAGRAM



SENSITIVITIES VS MAXIMUM PROBE WIRE DISTANCE*

SENSITIVITY CHAR.	SENSITIVITY (KOHMS)	DISTANCE (FT)
A	4.7	900
B	10	600
C	26	250

**Based on type MTW or THHN wire, #14 or #16 Awg.*



OPERATION

AUTOMATIC RESET (Reset terminals not used): When the liquid rises to the electrode on terminal LLCO, the control energizes, changing state of the load contacts. (LED will be lit). The control remains energized until the liquid level recedes below electrode on terminal LLCO. The control then de-energizes, (LED will not be lit) returning load contacts to original state. Unless otherwise specified, there is a three second time delay on decreasing level. Liquid must be below probe on terminal LLCO for full three seconds before control de-energizes.

MANUAL RESET (Normally closed pushbutton installed across reset terminals): When the liquid rises to the electrode on terminal LLCO, the control will remain de-energized until the pushbutton is depressed. The control will then energize, (LED will be lit) changing the state of the contacts. The control remains energized until the liquid level recedes below electrode on terminal LLCO. The control then de-energizes, (LED will not be lit) returning load contacts to their original state. Unless otherwise specified, there is a three second time delay on decreasing level. Liquid must be below probe on terminal LLCO for full three seconds before control de-energizes.

MANUAL RESET OPTIONAL POWER OUTAGE FEATURE (Normally closed pushbutton across reset terminals): Control will ignore power loss to control. With liquid above electrode on terminal LLCO, a power outage will cause the control to de-energize, but, will automatically energize upon return of power. However, loss of liquid will cause control to de-energize and remain so until liquid again rises to electrode and pushbutton is depressed.

MODEL NUMBER DESIGNATION

26XXXX-X-XX

- Time Relay (decreasing level) 3 seconds standard, 6 seconds available
- Optional Character: See optional character chart below
- Enclosure: 0-none, 1-NEMA 1, 4-NEMA 4, 7-NEMA 7, 12-NEMA 12.
- Standoff Style: A-1/16" panel, B-1/8" panel, C-screw mount, D-retro fit
- Supply Voltage: 1-120VAC, 2-240VAC, 3-24VAC,*8-208/240VAC
- Mode/Sensitivity: Direct A-4-7K, B-10K, C-26K
- SERIES 26 CONTROL / with reset tabs

* 187 Vmin to 255 Vmax VAC

OPTION CHARACTER CHART

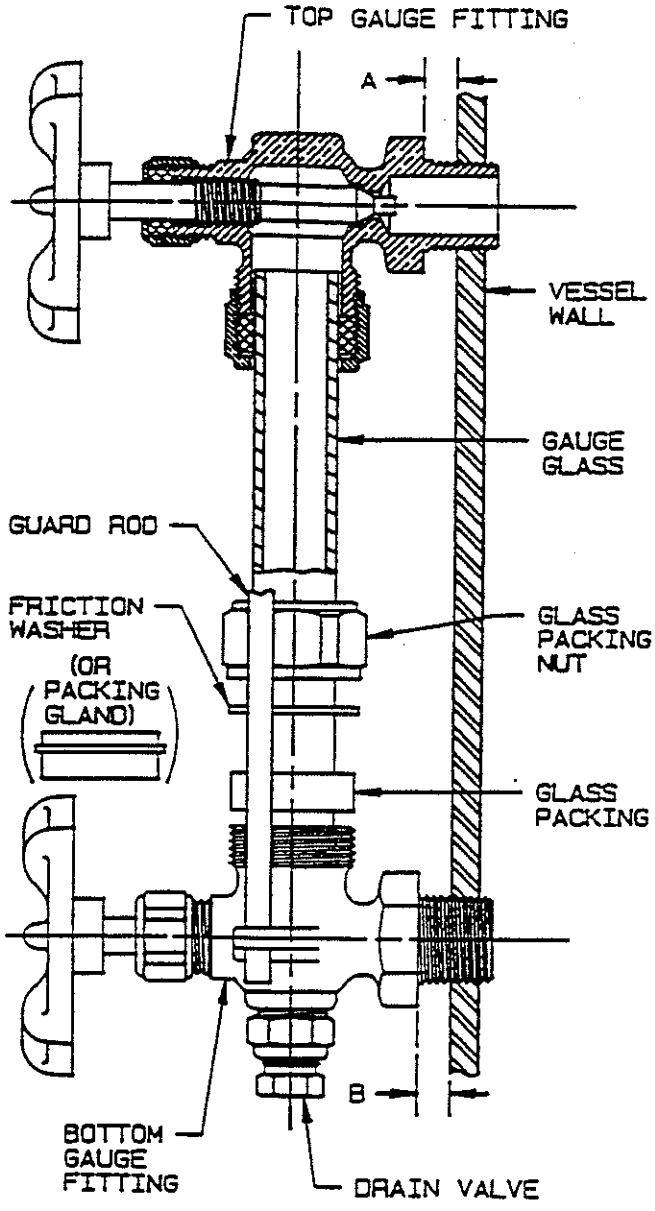
	NORMALLY CLOSED PUSHBUTTON	POWER OUTAGE FEATURE	RETRO FIT PLATE
C	X		
E		X	
F	X	X	
N		X	X
P	X	X	X
R			X

CONBRACO WATER GAUGE & GAUGE GLASS INSTALLATION INSTRUCTIONS

INSTALLATION

Only properly trained personnel should install and maintain water gauge glass and connections. Remember to wear safety gloves and glasses during installation. Before installing, make sure all parts are free of chips and debris.

1. Apply Teflon tape or pipe dope to pipe threads. Install top gauge fitting (fitting without a drain valve) into the uppermost tapping. Wrench tighten the fitting until it is snug and the glass outlet is pointing at five o'clock (about 1/8 turn from its final downward vertical position).
2. Install the bottom gauge fitting (the fitting with a drain valve) until it is snug and the glass outlet is pointing directly upward. Verify top and bottom fittings are threaded into the tappings the same number of turns (distance A=distance B).
3. Remove glass packing nut, friction washer (or packing gland, depending upon the model), and glass packing from the fittings, and place them, in the same order, on to both ends of the gauge glass. Push both packings about an inch up the gange glass.
4. Gently insert one end of the glass into the top gauge fitting. Keeping the glass inside the top fitting, gently rotate the top gauge fitting clockwise until vertically aligned with the bottom gauge fitting, then insert glass into bottom fitting until glass bottoms out on the shoulder inside the bottom fitting.
5. Carefully raise glass bout 1/16" and slide lower glass packing down until the glass packing contacts the lower gauge fitting. <u>DO NOT</u> allow the glass to remain in contact with any metal!
6. Carefully slide upper glass packing up as far as possible.
7. Hand tighten both glass packing nuts, then tighten 1/2 turn more by wrench. Tighten only enough to prevent leakage. DO NOT OVER TIGHTEN! If any leakage should occur, tighten slightly, a quarter turn at a time, checking for leakage after each turn.



CONBRACO

P.O. BOX 247
MATTHEWS, NORTH CAROLINA 28106
MADE IN U.S.A.
I-5334-00 Rev. C

WATER GAUGE GLASS

NOTICE: READ ALL WARNINGS AND INSTRUCTIONS BEFORE PERFORMING INSTALLATION OR MAINTENANCE.

WARNING!

SAFETY GLASSES AND GLOVES SHOULD BE WORN AT ALL TIMES WHEN WORKING WITH OR EXAMINING WATER GAUGE GLASS AND CONNECTIONS.

IMPROPER INSTALLATION OR MAINTENANCE OF GAUGE GLASS AND CONNECTIONS CAN CAUSE IMMEDIATE OR DELAYED BREAKAGE RESULTING IN BODILY INJURY AND/OR PROPERTY DAMAGE.

USE AND CARE

DO NOT'S

DO NOT use glass if it contains any scratches, chips, or any other visible signs of damage.
DO NOT reuse any tubular glass or glass packings.
DO NOT subject gauge glass to bending or torsional stresses.
DO NOT over tighten glass packing nuts.
DO NOT allow glass to touch any metal parts.
DO NOT exceed the recommended pressure of the gauge or gauge glass.
DO NOT clean the gauge or gauge glass while pressurized or in operation.

CONBRACO

CONBRACO INDUSTRIES, INC.
P.O. BOX 247
MATTHEWS, NORTH CAROLINA 28106
MADE IN U.S.A.

WATER GAUGE GLASS

DO'S

DO verify proper gauge has been supplied.
DO examine gauge glass and packings carefully for damage before installation.
DO install protective guards and utilize automatic ball checks where necessary to help prevent injury in case of glass breakage.
DO inspect the gauge glass daily, keep maintenance records, and conduct routine replacements.
DO protect glass from sudden changes in temperatures such as drafts, water spray, etc.

MAINTENANCE

Examine the gauge glass regularly for any signs of clouding, scratching, erosion, or corrosion. The glass should be inspected daily until the need for replacement becomes apparent. This will help establish the routine inspection and routine replacement schedules.

CLEANING

Use commercial non-abrasive glass cleaners to keep glass clean. Use diluted acids such as Hydrochloric (muriatic) acid when regular cleaners do not seem to work. Do not use wire brushes or any other abrasive materials which could scratch the glass.

INSPECTION

Examine the surface of the glass for scratches, corrosion, chips, cracks, surface flaws, or nicks. To do this, shine a very bright concentrated light at an angle of about 45 degrees. A defective glass will glisten as the light strikes imperfections. Glass which appears cloudy or roughened, and will not respond to cleaning, should be replaced.

STORING

Keep gauge glass in original packaging until ready to install.

I-5334-00 Rev. C